

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE

GOG/mw

615 Commerce Building
St. Paul, Minnesota

January 26, 1934

1912 and 1929 ADJUSTMENTS OF THE

UNITED STATES LEVEL NET

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1. This office has continued to use the 1912 (4th General) adjustment of the United States level net in its work, because at the time the flowage surveys were started, the 1929 (5th General) adjustment was not available. Since that time such a large amount of survey work has been done on the basis of the 1912 adjustment that to start using the 1929 adjustment would incur much confusion. It might also be noted that up to the present time the 1929 adjustment for the St. Paul District area is published only in mimeograph form and not in complete bulletins for each state. As noted in the following paragraphs, the differences between the 1912 and 1929 adjustment for various points in the St. Paul District, are very nearly uniform and thus there is no advantage to be gained by abandoning the 1912 adjustment, especially in view of the large amount of survey work already completed on the 1912 basis.

2. Perhaps the best discussion of the 1929 adjustment of the level net of the United States is given in the November-December 1932 issue of the Military Engineer. The article is written by Howard S. Rappleye, Mathematician of the United States Coast and Geodetic Survey and goes into some detail as to the reasons for the 1929 adjustments. Most of the information given below is from the article by Mr. Rappleye.

3. In the 1912 (4th General Adjustment) of the United States level net, results of which are published in special publication 18 of the U. S. Coast and Geodetic Survey, the eastern half of the country was not readjusted but was held fixed as adjusted in 1903. By 1929 the total leveling in the United States had increased from about 30,000 miles in 1912 to more than 45,000 miles, making a new general adjustment of the level net advisable in order to bring the resulting elevations more nearly to their true values. The 1929 adjustment is really the first complete general adjustment since 1903, because in the 1907 and 1912 adjustments, the eastern half of the United States was held fixed as adjusted in 1903.

4. In 1927 a special adjustment of the level net in the United States was made, without holding mean sea level fixed at the various tidal stations. After the adjustment was completed, comparison of the observed differences of mean sea level resulting from the tidal observations indicated that the mean sea level surface as defined by tidal observations has a tendency to slope upwards to the north along both the Pacific and Atlantic Coasts with the Pacific noticeably higher than the Atlantic. For example, the actual difference between Fort

Stevens, Oregon, on the Pacific Coast, and Old Point Comfort, on the Atlantic Coast, is about 2.85 feet. As a result of these differences, the entire level net of the United States was re-adjusted in 1929 to fit the tidal observations. All Canadian level nets were also included in the adjustment.

5. To quote Mr. Rappleye, it might be stated: "It must be understood that the absolutely correct elevation for any bench mark will never be known. Additional leveling and re-adjustments of the leveling on the net would result in elevations which would be so close to the truth that subsequent adjustments would change them by amounts so slight as to be of no practical importance."

6. The differences between the 1929 adjustment and the 1912 adjustment are rarely greater than foot over the entire United States.

7. For the area in the vicinity of the St. Paul District the following is given to show some idea of the differences:

| Permanent Bench Mark (PBM) | CITY | STATE | Elevation 1929 Adjustment | Elevation 1912 Adjustment | Difference in Feet |
|----------------------------|-------------------------------|-----------|---------------------------|---------------------------|--------------------|
| 67 | St. Paul | Minnesota | 707.656 | 708.138 | .54 |
| 112 | Red Wing | Minnesota | 687.328 | 687.807 | 0.479 |
| 128 | Lake City | Minnesota | 669.132 | 689.615 | 0.483 |
| 140 | Wabasha | Minnesota | 690.064 | 690.550 | 0.486 |
| 164 | In Wisconsin, opposite Winona | Minnesota | 646.993 | 647.479 | 0.486 |
| 192 | La Crosse | Wisconsin | 679.159 | 679.651 | 0.492 |
| 203 | Genoa | Wisconsin | 656.367 | 656.849 | 0.482 |
| 232 | Prairie du Chien | Wisconsin | 630.612 | 631.068 | 0.456 |

G. O. Guesmer
Assistant Engineer
January 26, 1934

DATUM CORRECTIONS

1929 Elevation + Correction = 1912 Elevation

| Location | 1929 | 1912 | Memphis Datum |
|------------------|------|------|------------------|
| Bena | 0.54 | | |
| Deer River | 0.50 | | |
| Pokegama Dam | 0.47 | 7.90 | 8.37 |
| Brainerd | 0.35 | 7.71 | 8.16 |
| Sartell | 0.30 | | |
| Sauk Rapids | 0.29 | | |
| St. Cloud | 0.30 | 7.70 | 8.00 |
| Clearwater | 0.31 | | |
| Monticello | 0.35 | 7.56 | 7.91 |
| Elk River | 0.38 | 7.51 | 7.89 |
| Anoka | 0.41 | | |
| Minneapolis | 0.45 | 7.34 | 7.79 |
| St. Paul | 0.48 | 7.30 | 7.78 |
| Red Wing | 0.48 | 7.21 | 7.69 |
| Lake City | 0.48 | 7.18 | 7.66 |
| Wabasha | 0.48 | 7.14 | 7.62 |
| Winona (Wisc.) | 0.49 | 7.09 | 7.58 |
| La Crosse | 0.49 | 7.03 | 7.52 |
| Genoa | 0.48 | 6.98 | 7.46 |
| Prairie du Chien | 0.46 | 6.89 | 7.35 |

WAR DEPARTMENT

United States Engineer Office, St. Paul, Minnesota

**Difference Between Mean Sea Level Datum (1912 Adjustment)
and Memphis Datum - Minneapolis, Minnesota, to Clayton, Iowa**

| Miles Below Minneapolis | Description or Benchmark | Having MSL (1912 Adj) Elevation. To Obtain Elevation in Memphis Datum Add - (feet) |
|-------------------------------|---------------------------------------|---|
| 0.1 | PBM University Campus | 7.34 |
| 0.2 | PBM Pillsbury Hall (Mpls) | 7.34 |
| 3.08 | Stone line 264 | 7.34 |
| 5.4 | T. C. L. & D. (#1) | 7.30 |
| 13.53 | PBM 67 St. Paul, Minnesota | 7.30 |
| 13.83 | P.B. M.'s 70-71 | 7.30 |
| 15.95 | Stone line 260 | 7.29 |
| 18.93 | Stone line 259 | 7.29 |
| 19.9 | PBM's 77-78 | 7.28 |
| 25.33 | Stone line 257 | 7.28 |
| 28.50 | Stone line 256 | 7.27 |
| 31.65 | Stone line 255 | 7.26 |
| 33.6 | PBM's 85-86 | 7.27 |
| 35.45 | Stone line 254 | 7.26 |
| 37.8 | Hastings L & D (#2) | 7.25 |
| 39.15 | Hastings, Minnesota Highway Bridge | |
| 44.63 | Stone line 251 | 7.25 |
| 45.72 | PBM's 94-95 | 7.24 |

Difference Between Mean Sea Level Datum (1912 Adjustment)
and Memphis Datum - Minneapolis, Minnesota, to Clayton, Iowa

| Miles Below Minneapolis | Description or Benchmark | Having MSL (1912 Adj) Elevation. To Obtain Elevation in Memphis Datum Add - (feet) |
|-------------------------------|---------------------------------------|---|
| 47.85 | Stone line 250 | 7.24 |
| 48.55 | PBM's 98-99 | 7.23 |
| 54.02 | Stone line 248 | 7.23 |
| 56.09 | Dam #3 Site | |
| 57.42 | Stone line 247 | 7.22 |
| 60.66 | Stone line 246 | 7.22 |
| 62.23 | PBM's 110-111 & 112 | 7.21 |
| 62.37 | Red Wing, Minnesota Highway Bridge | |
| 63.3 | Triang. Sta. Lower Base | 7.21 |
| 63.97 | Stone line 245 | 7.20 |
| 69.8 | Stone line 243 | 7.20 |
| 73.46 | Stone line 242 | 7.19 |
| 76.55 | Stone line 241 | 7.19 |
| 76.6 | PBM's 124-125 | 7.18 |
| 79.0 | Stone line 240 | 7.18 |
| 80.1 | Lake City, Minnesota | |
| 80.4 | PBM 128 & PBM 129 | 7.17 |
| 84.1 | Triang. Sta. Lakeport | 7.17 |
| 85.6 | Stone line 238 | 7.16 |
| 90.32 | Reads, Minnesota Pontoon Bridge | |
| 91.72 | Stone line 236 | 7.16 |
| 92.91 | PBM 140 | 7.15 |

Difference Between Mean Sea Level Datum (1912 Adjustment)
and Memphis Datum - Minneapolis, Minnesota, to Clayton, Iowa

| Miles Below Minneapolis | Description or Benchmark | Having MSL (1912 Adj) Elevation. To Obtain Elevation in Memphis Datum Add - (feet) |
|-------------------------------|--------------------------------------|---|
| 95.78 | PBM's 143-144 | 7.15 |
| 97.77 | Stone line 234 | 7.14 |
| 100.20 | Dam #4 Alma, Wisconsin | |
| 100.55 | PBM 148 | 7.13 |
| 104.9 | PBM's 151-152 | 7.13 |
| 107.06 | Stone line 231 | 7.12 |
| 110.95 | Stone line 230 | 7.11 |
| 114.09 | Stone line 229 | 7.11 |
| 114.88 | Dam #5 | |
| 117.20 | Stone line 228 | 7.10 |
| 119.5 | Fountain City, Wisconsin | |
| 121.7 | PBM 160 | 7.10 |
| 123.85 | Stone line 226 | 7.09 |
| 124.50 | Dam #5A | |
| 127.31 | Winona, Minnesota, Highway Bridge | |
| 130.82 | Stone line 224 | 7.09 |
| 131.00 | PBM 170-171 | 7.08 |
| 134.45 | PBM 174-175 | 7.08 |
| 137.10 | Stone line 222 | 7.07 |
| 138.5 | Trempealeau, Wisconsin | |
| 138.71 | Dam #6 | |
| 140.13 | Stone line 221 | 7.06 |
| 141.4 | PBM 178 | 7.06 |

Difference Between Mean Sea Level Datum (1912 Adjustment)
and Memphis Datum - Minneapolis, Minnesota, to Clayton, Iowa

| Miles Below Minneapolis | Description or Benchmark | Having MSL (1912 Adj) Elevation. To Obtain Elevation in Memphis Datum Add - (feet) |
|-------------------------------|-----------------------------|--|
| 142.84 | Stone line 220 | 7.06 |
| 143.5 | PBM's 180-181 | 7.05 |
| 147.6 | PBM 184 | 7.05 |
| 148.4 | PBM's 185-186 | 7.04 |
| 149.54 | Stone line 218 | 7.04 |
| 150.54 | Dam #7 | |
| 152.30 | Stone line 217 | 7.03 |
| 154.9 | LaCrosse, Wisconsin | |
| 155.22 | PBM 193 | 7.03 |
| 155.77 | Stone line 216 | 7.02 |
| 158.3 | PBM's 194-195 | 7.02 |
| 158.82 | Stone line 215 (new) | 7.01 |
| 159.17 | Stone line 215 (old) | 7.01 |
| 162.1 | Stone line 214 | 7.00 |
| 165.4 | Stone line 213 | 6.99 |
| 173.45 | PBM 203 | 6.99 |
| 173.76 | Dam #8 Genoa, Wisconsin | |
| 176.08 | Stone line 210 | 6.98 |
| 177.1 | PBM's 204-205 | 6.98 |
| 179.40 | Stone line 209 | 6.96 |
| 187.5 | PBM's 213-214 | 6.96 |
| 189.43 | Stone line 206 | 6.95 |
| 190.0 | Lansing, Iowa | |

Difference Between Mean Sea Level Datum (1912 Adjustment)
and Memphis Datum - Minneapolis, Minnesota, to Clayton, Iowa

| Miles Below Minneapolis | Description or Benchmark | Having MSL (1912 Adj) Elevation. To Obtain Elevation in Memphis Datum Add - (feet) |
|-------------------------------|----------------------------------|--|
| 192.12 | Stone line 205 | 6.94 |
| 197.85 | PBM's 219-220 | 6.94 |
| 198.18 | Stone line 203 | 6.93 |
| 200.0 | PBM's 221-222 | 6.93 |
| 202.79 | Stone line 202 | 6.92 |
| 205.06 | Dam #9 | |
| 208.10 | PBM's 226-227 | 6.92 |
| 209.20 | Stone line 200 | 6.91 |
| 212.8 | PBM's 229-230 | 6.91 |
| 214.82 | Stone line 198 | 6.90 |
| 217.7 | Triang. Sta. South Base | 6.90 |
| 217.8 | PBM 232 | 6.89 |
| 219.3 | Triang. Sta. Prairie du Chien | 6.89 bolt |
| | Triang. Sta. Prairie du Chien | 6.95 Pipe (Probably moved) |
| 219.3 | Prairie du Chien, Wisconsin | |
| 221.2 | Stone line 196 | 6.88 |
| 228.20 | PBM 241 Clayton, Iowa | 6.88 |

Note: Differences M.S.L. (1912 Adj.) To Memphis taken from Map File 133-E, Mississippi River, Comprehensive Tabulation of Physical Data. This list shows only points at which a change in difference occurs. There are several instances where the bench marks in between points shown may differ 0.01 foot from differences shown. Where extreme accuracy is required it is suggested that Map File 133-E or the various bench mark

publications be consulted.

The mileages of dams are the latest obtained by Mr. G. E. Lyon and refer to the center line of the service bridge.

"Stone line" is the M.R.C. designation for several (title and pipe) bench marks set in a line, generally at right angles to the direction of the valley, across the valley floor. "Stone lines" are generally located about every three miles along the Mississippi River and consist of three or four bench marks.